Report No. 2

PROGRAM RECOMMENDATIONS AND RESEARCH AND TECHNOLOGY GOALS: IMPROVED INFORMATION AIDS FOR TECHNICIANS

Society for Applied Learning Technology

under support from
Educational Testing Service
Princeton, New Jersey

February, 1976

Sponsored by

Advanced Research Projects Agency
ARPA Order No. 2651
Contract No. MDA 903-74-C-0290

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INTRODUCTION

Over the past twenty-five years there have been numerous efforts to improve the information used by maintenance technicians in the performance of their jobs. Scores of research studies have been published, often with results bordering on the spectacular. But little has been done to apply these results in day-to-day operations; technical manuals remain much as they have been for decades.

Fortunately, there are promising developments underway, and there seems to be a current willingness in DoD to consider new techniques for providing job information if it can be shown that they will contribute to increasing readiness or decreasing costs. Extrapolating laboratory results to the real world with huge hypothetical savings is not convincing. The problem of providing effective maintenance in the field is a complex one and much remains to be learned before the apparent benefits of innovation can be realized.

The Society for Applied Learning Technology has completed information development, program definition and recommendations for future action in the area of "Improved Information Aids for Technicians" which represents participation and contribution from over 80 professionals in the field and will lead to initiation of futher development efforts by means of both a national conference and an interdisciplinary focus on the part of professional societies and industry associations dealing with the technical and product problems to be addressed by the recommended program.

It is clear that a major area of improvement in instruction delivery and job performance can be made through the introduction of automated instruction devices and fully proceduralized job performance aids. Implementation of this technology through techniques which have already been demonstrated could lead to major manpower reductions in the Department of Defense, as well as increased competence and mobility of the civilian labor force.

It is equally clear that the problem areas requiring solution are large. In order to develop successful recommendations, issues considered included a review of techniques and application (both media and delivery mechanisms), as well as the span of the management areas which must be involved in large scale implementation. The weapon logistics planners and managers, personnel, and training program planners, and the operational people must all be involved to carry off innovation. All of these areas were considered since they must all interact in order for innovation demonstrated on a small scale to come into being in the real world on a large scale.

In developing recommendations the issues of technology transfer, communications programs to implement this, and research requirements were considered paramount. The Society's recommendations therefore center on these issues.

RESEARCH NEEDS

These are listed below the principal needs for research in the area of Improved Information Aids for Technicians as determined by the Society. It should be noted that research must be accompanied by widespread information transfer and communication which recognizes that improving job information is a system-wide problem extending well beyond the training and technical documentation communities.

1) How generalized are results from a demonstration involving particular equipment? It was observed that there are common features in all systems-functions like align, remove, etc., and the use of test equipment and tools in common.

2) How do the problems of applying this technology to new systems differ from applying it to established systems?

3) What is troubleshooting and how do you teach it?

4) Experimentation should be done with an interactive device with a large memory serving both training and job aiding.

5) The "up or out" policy should be modified on a trial basis to allow maintenance E-4's to stay in at that level to measure the impact on maintenance costs.

6) A survey is needed at operations, supervision and command levels to uncover problems.

7) A general maintenance model is needed.

8) Techniques are needed for covering ATE interfaces in the prime equipment training program and manuals and prime equipment interfaces in ATE training and manuals.

9) Investigate the value of combining the good features of several systems such as JPA, SIMM, and the traditional technical manual/trouble approaches rather than looking for one stand out system for all situations. The JPA approach, as an example, when used exclusively has some serious shortcomings.

10) Investigate the cost effectiveness of unique approaches such as the technical manual approach prepared for maintenance/troubleshooting of the ATE for the Torpedo Mk 46. This Torpedo Mk 46 ATE approach appears to be a substantial improvement over the SIMM approach.

11) Investigate the desireability of using tools like Reliability Prediction (Failure Rate) information to identify the JPA's that would be of the most value.

12) Investigate the possibility and mechanics for obtaining substantial funds for technical manual and training investigative work from other than individual project office managers (including funds for the preparation of military specifications and data identification descriptions such as JPA maintenance information).

13) Investigate methods of improving the re-enlistment rate of submarine personnel sent to sea (such as torpedomen), of reducing the training workload on schools such as the AUW School, Orlando, due to the shore to sea rotation policy, and of increasing the knowledge of Commanding Officers and Weapons Officers of submarines in the use of their weapon systems without extending the shore based training time. These objectives could be obtained if we provided for training at other than our standard shore bases schools, and in the instance of submarine personnel provided training information for use aboard submarines. Torpedomen at sea (submarine on patrol station) could be taught to be able to maintain torpedoes at IMA shops and to be able to maintain associated shore based test equipment. When they complete their sea tour of duty they could "top off" their education by proving at the AUW School or at a IMA shop that they have aquired the depth of knowledge required. The methods to be investigated and referenced above would involve studies of self-paced individualized training material and presentation equipment requiring a minimum of instructor assistance. With the rotation of qualified torpedo maintenance personnel from shore to sea the Navy is placing on board submarine personnel that could act as "instructors"-- that is to answer questions of personnel being taught by the self-paced individualized training material and associated presentation equipment.

14) Is it possible to isolate and identify human actions required in the man machine performance prior to the development of the machine?

15) Is it possible to describe the structures into which these actions can be formulated?

16) Can measurements and advance validation of these actions be determined?

17) Is it possible to tie specific elements of job information delivery to an engineering analysis system?

18) Is it possible to assess complexity of maintenance tasks in varying or dissimilar technologies?

19) Is it possible to postulate a management system which would regard individuals as repositories of units of information for the purpose of determining capability?

20) Can optimum instruction/performance algorithms be developed for varying profiles of individuals or groups?

21) Is it possible to establish criteria and evaluate performance for specific maintenance actions?

22) Can job information requirements be related both to military occupational specialty as well as to job performance requirements?

23) Can we postulate force readiness criteria as a function of job information alternatives and costs?

24) Total survey of all current effort presently being pursued. Publish, then hold OSD level conference to discuss.

25) Development of philosophy inherent in Weapon System Acquisition which requires early identification of all training cost elements--and the full funding of these items throughout program evolution.

26) Develop management philosophy to identify technical leadership within the DoD which coordinates, identifies, and permeates all using components, and develop an OSD level continuing steering group on training per se.

27) Develop stronger and more meaningful (perhaps thru DSARC process) controls in equipment design to force recognition of the requirement for ease of maintenance.

TECHNOLOGY TRANSFER

REQUIREMENTS FOR EDUCATION AND COMMUNICATION

Numerous publications were cited as representative of liturature available on job performance information for technicians. It was a generally held conclusion, however, that no central point exists for the communication of this information. Consequently, a focused and continuing effort was suggested in order to accomplish the necessary information transfer to project managers, executives and engineers and to achieve widespread understanding of the potential and use of these techniques. Below are outlined the key actions considered necessary to initiate an education and communication program to industry, DoD and the education community.

Quarterly Newsletter

A quarterly newsletter was recommended. Initially, the letter would be distributed to individuals within The Department of Defense, and DoD contractors involved in development of training materials. It would focus primarily on technical papers and training accomplishments. Secondarily, events of interest in the fields of education and training would be included. The purpose would be to maintain the current knowledge level of job information systems for individuals working in the field, and serve as a current information interchange mechanism.

To initiate such a newsletter, it would be necessary to develop a list of individual and/or organization addresses; organize a format and topic structure; and organize a method for documentation.

Automated Search and Retrieval System

The Hughes Aircraft Company maintains a data file of job information aids and has offered to make this collection available to SALT. Thus, SALT, on a service basis, would be in a position to distribute such data using automated search and retrieval techniques. It was recommended that SALT establish a link to the Hughes data base, a means for entering the file for search, and offer this service to all on a basis to be defined.

Books and Permanent Reference Material

Little or no published material is available, such as texts or reference books, on the subject of job information aids. It was recommended that DoD contract to (1) abstract current liturature and publish a reference book, and (2) develop (in conjunction with univeristies and the DoD schools) materials for publication as text and reference documents for use in Institutes, workshops, and defense education programs.

Distribution of Research Reports

Currently, liturature on research is typically published in a DoD or professional journal and indexed (or possibly abstracted) for insertion into

a search file. There is no on-going effort to reproduce and market reports to those who might need them. Conversely, it is often a time consuming and costly proposition to find relevant work. Therefore, the recommendation was made that current JPA reports, be actively marketed and republished as necessary in order to obtain wider distribution and a greater dissemination of available information.

DoD/Industry Workshops

Workshops on education and training subjects should be developed, offered and conducted, either on an in-plant basis or at central locations. Suggested sponsors for this activity include professional societies, industry associations, and universities. It was suggested these courses be of short duration with frequent scheduling.

DoD Formal Courses

It was recommended that the Defense Systems Management School, Industrial College of the Armed Forces, and the National War College offer formal courses in job information aids for technicians to senior officials and project managers. Such courses might be for degree credit with appropriate university sponsorship, or offered as institutes.

Publication of a Journal

Presently, job implementation technology is accomplished by technicians who have no recognized technical focus or forum for publication. A professional journal on job information technology was recommended to provide a forum of communication and recognition for the practitioner as well as the researcher.

Libraries

It was generally agreed that industrial and engineering libraries have little or no information on job information technology, performance architecture and related topics. It was proposed that a program be initiated to communicate with this library community and establish lists of publications which should be acquired; and, on a continuing basis, work with the libraries to assist them in establishing meaningful and complete reference information in this technical field.

Notation and Terminology

It was concluded that notation, terminology, and meaning in the job performance information field is not uniform nor is there a comprehensive compendium available. Accordingly, it was a final recommendation that DoD sponsor an effort to collect, assess, organize and publish an anthology of terminology and notation. To assure uniformity and acceptance, a technical panel would be established to referee meaning and conduct an on-going effort to maintain the reference work current.

The data included in the, "Proceedings of the Invitational Conference on Improved Information Aids for Technicians," provides considerable information which can be applied to the training of handicapped and minority individuals. This material, while aimed at the training of people in a military setting, is a description of procedures which have the potential of being transferred to the development of people in any job related setting.

Basic to the thinking embodied in this conference is the application of the systems approach to training. Using this concept, objectives are first established by analyzing the job to be done, followed by a detailed plan of how this work is to be accomplished. This approach had direct applicability to the development of job skills and performance for handicapped and minority people. The objective in both situations is the same. That is, human performance on the job. It does not matter that the individual being employed may be unable to perform certain physical activity, or have some kind of a sociological derived handicap.

It should be noted that the procedures which have been developed and were described at this conference, and the typical applications outlined, assume that the individual being trained or working on the job is free from significant physical and mental handicapps. While this is a valid assumption in such a military setting, the procedures are readily applicable to other types of employment situations. The techniques are work centered, they provide step-by-step instruction, the work is properly sequenced, the materials contain only pertinent information, and the tasks have been designed to fit the person.

In proposing to transfer the training and job performance technology, which has been developed in the setting described in the conference, a number of factors must be considered. First, in employing handicapped and minority individuals, an employer must consider the matching of specific people to specific jobs. This is in contrast to matching a typical or specified class of people to a particular or specified class of jobs. The handicapping condition of a particular individual, for example, may not be duplicated in any other individual at that particular place of work.

Secondly, as was pointed out in the conference, after defining the job it must then be subdivided into tasks (task analysis). This identification of tasks can be done by observation, the use of questionnaires, the interviewing of people presently doing the same work, or by some other technique. This identification of tasks in the case of the handicapped individuals , however takes on more emphasis than when operating in the military or a like setting. It may be impossible, for example, to define the required work tasks by any means other than observing the particular capabilities of the specific individual involved. This is different from the development setting, where a class of individuals with assumed or specified capabilities were available. Thus, the point is, the transfer of this technology for use with a different population can be readily accomplished in a procedural sense, but the steps may take on a different emphasis.

The conference proceedings also point out, that after task identification the next step in matching the handicapped type person to a specific job concerns the analysis of the tasks which have been identified. While this is accomplished to some degree in the identification task, a more detailed analysis is required before a training program can be developed or before it can be assured that the person can indeed accomplish all that is required. The Task Identification Matrix (TIM) described during the conference would seem to be a tool by which this could be accomplished. Admittedly, this tool was not designed for this purpose but the roots of the technique go back to early vocational educational developments and it should prove easily adaptable to special uses in job structuring situations of the handicapped type.

Other techniques described in the conference also show promise as possible candidates for transfer and use in training populations other than the ones for which they were developed. These will not be enumerated but all are described in the proceedings which document the conference.

It is thus recommended that a program of research be undertaken to identify and adapt procedures and techniques currently being developed and used by the military services for use by handicapped and minority populations. Such a research program should be an extension of the research needs articulated under a different heading of this report.

Secondly, it is recommended that a program of communications be established to connect the military development community with the professional community which is serving the handicapped and minority populations. The communications effort should take several forms in order to reach as many elements of the handicapped and minority population as possible. This is also outlined at another point in this report.